Chapter 20

Disentangling the causal structure underlying environmental regulation

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Abstract

In this chapter we seek to disentangle the causal structure underlying environmental regulation with the help of Structural Equation Modelling (SEM) for a data set of 47 countries. SEM is a method for estimating revealing causal structures, allowing the analyst to examine whether the influence of variable A occurs in combination with variable B through variable C or through D, as co-determinants of E. Green advocacy and strong governance capacity are the main structural determinants of environmental regulation stringency. Internet access has a positive influence on environmental regulation through green advocacy and governance capacity. The influence of green advocacy and governance capacity on international environmental governance takes place through national environmental policy, while international environmental governance is also influenced by factors beyond the scope of this chapter. Statistically, 92% of the variance of environmental policy output was explained by our structural model, which is very high for a model incorporating only structural factors.

20.1 Introduction

Almost all countries have adopted environmental policy measures, with different degrees of regulatory stringency (OECD, 2013). The development of such policies is generally believed to depend on many different factors: green politics, a capable and well-staffed administration responsible for green issues, international pressures (such as the environmental acquit in the case of the accession countries in the EU), lobbying by green business actors, and acceptance by polluters.

The present study is an attempt to disentangle the causal structure and structural determinants of environmental policy, with the help of a rigorous analysis in the form of Structural Equation Modelling (SEM). SEM is a method for revealing causal structures, allowing the analyst to examine whether the influence of variable A occurs in combination with variable B through variable C or through D, as co-determinants of E. We sought to disentangle the causal structure underlying environmental regulations with the help of SEM for a data set of 47 countries, distinguishing between the influence of *proximate* factors such as governance capacity and demand for environmental regulations (from green business and green activists) and *background* factors such as democracy, internet access, environmental knowledge, and social cohesion.

20.2 Determinants of environmental policy

No fully-fledged theory of environmental policy making exists, but useful attempts to build one have been made. One relevant scheme is the framework of environmental policy diffusion created by Tews et al. (Tews, 2005). This framework makes a distinction between horizontal and vertical diffusion of environmental policy. Horizontal policy diffusion occurs when environmental policy is transferred from lead countries to other countries, while vertical diffusion takes place when international organisations set policies which are being implemented by countries. The different factors in this approach are grouped into two categories (Tews, 2005): (i) dynamics of the international system and (ii) national factors.

Given the sovereignty of nation states, national factors are viewed as decisive for the various designs of environmental policies across countries (see also Kern, Jörgens, & Jänicke, 2001). Whether governments want to adopt an environmental policy agenda depends on their institutional capacity, and these national capacities set the limits to policy innovation. Distinct country characteristics as well as a country's structural framework can influence national environmental policy (Tews, 2005). Relevant country characteristics include the size of a country, its market volume, and its contextual reputation (Tews, 2005), but they are not determinants of environmental policy.

The structural determinants of environmental policy are: environmental policy capacity, green parties, green advocacy coalitions, knowledge about environmental

problems, active or passive support for regulations among the wider public, and acceptance of regulations by business and citizens who are directly affected by them (Jaenicke, 2005; Vogel, 1986). Put differently, environmental policy capacity refers to "a society´s ability to identify and solve environmental problems" (OECD, 1994, p. 8).

Environmental policy theory has been based on interest groups and constitutional structures (summarised in Oates & Portney, 2003) but has offered a rather crude description of interactions and failed to consider wider structural conditions and distal factors such as the role of environmental knowledge. We opt for a different approach, building on the work of Martin Jaenicke and other scholars, which is based on political-institutional and cognitive-informational framework conditions (Jaenicke & Weidner, 1997, p. 11; Mason, 1999). The former describe more structural conditions as requirements in the policy cycle, ranging from sensing a problem, agenda setting, and target formulation to decision and implementation (Jaenicke, Kunig, & Stitzel, 1999). An important element of political-institutional structural conditions is "green" advocacy coalitions of private and public actors (Sabatier, 1999), including civil society engagement in creating a sustainable future as well as the strength of the green industry in a country. Further potential political-institutional factors include the government's effectiveness, the competence of civil servants, and the quality of bureaucracy. The cognitive-informational framework conditions are systemic preconditions that relate to individuals' values and knowledge, and the communication channels through which they learn and express themselves. These can involve the degree of democratisation, access to the internet, environmental knowledge generation, and interpersonal trust.

It is important to note that not only structural but also economic factors can influence the policy output. Higher levels of national income and individual disposable income increase the availability of financial and technical resources and can improve the capabilities of a system to solve environmental problems (Jaenicke, 2005). The influence of this factor was tested post hoc (in the structural equation model analysis and in a separate linear regression analysis) but it was found not to have a significant influence, which is why we have not included it in our model.

In the following we discuss each of the types of conditions, starting with the political-institutional framework conditions, which directly influence the environmental policy-making process (as proximate factors).

20.3 Methodology and model

The determinants of environmental policy were investigated with the help of a Structural Equation Model (SEM) incorporating manifest and latent variables based on partial least squares. This is the preferred method when the theory underlying a structural model is not well established (Hair, et al., 2014). It allows the inclusion of

unobservable, latent variables, which are measured indirectly by indicator variables (Hair et al., 2014). The inner model describes the relationship between independent and dependent latent variables, while the outer model, also known as measurement model, specifies the relationship between observed indicators and the latent variables.

All variables are structural variables and are measured at a high level of aggregation (at country level). The analysis is restricted to the systemic conditions for policy-making action and investigates the normative and particular organisational aspects of policy mechanisms (polity) as the basis for the choice of instruments and national decision making (Jaenicke, 1992). Our approach does not allow us to analyse the choice of policy instruments (policy), nor does it enable us to analyse the policy-making process (the wheeling and dealing between politically active parties involved in environmental policy making).

The structural model (see Figure 20.1) consists of the constructs of Green Advocacy, Awareness, and Governance Capacity as independent latent variables, constituting "environmental policy capacity" and influencing the dependent latent variable of Environmental Policy. All manifest variables directly or indirectly constitute the national drivers (stimuli) for Environmental Policy. We hypothesised that Green Advocacy and Governance Capacity represent the political-institutional conditions of the polity, which is categorised into the two groups of manifest variables, Public Sector and Private Sector/Individuals. Awareness represents the construct for cognitive-informational conditions. The construct of International Environmental Governance interacts with national Environmental Policy. The direction of causality of this link (see Figure 1, option 1 or 2) is discussed below.

We postulate that cognitive-informational framework conditions, the capacity to generate and effectively distribute knowledge, influence the political-institutional framework conditions. However, we hypothesise that Awareness does not directly influence the policy output. Policy output is believed to stem from the interactions of green advocacy actors with the administration and political actors.

The following data were used in the analysis (see also Table 20.1 below). *Environmental Activism* exemplifies the degree to which civil society at local level cooperates with the local governments to create a sustainable future. *Competitiveness of Green Industry* is a measure of the innovative strength of environmental technology sectors and their power in the policy-making process. *Government Effectiveness* describes the competence of civil servants and the quality of bureaucracy which enhances a society's ability to effectively translate environmental concerns into regulation. *Democratisation* supports the transparent flow of information and helps citizens to express their concerns about environmental problems. *Internet Access* enables quick and inexpensive access to information. *Interpersonal Safety and Trust* represents social cohesion, enhances effective linkages among individuals, and lowers the transaction cost of information sharing. *Publications in the Environmental Domain* (environmental knowledge) promote decision-making with regard to environmental issues.

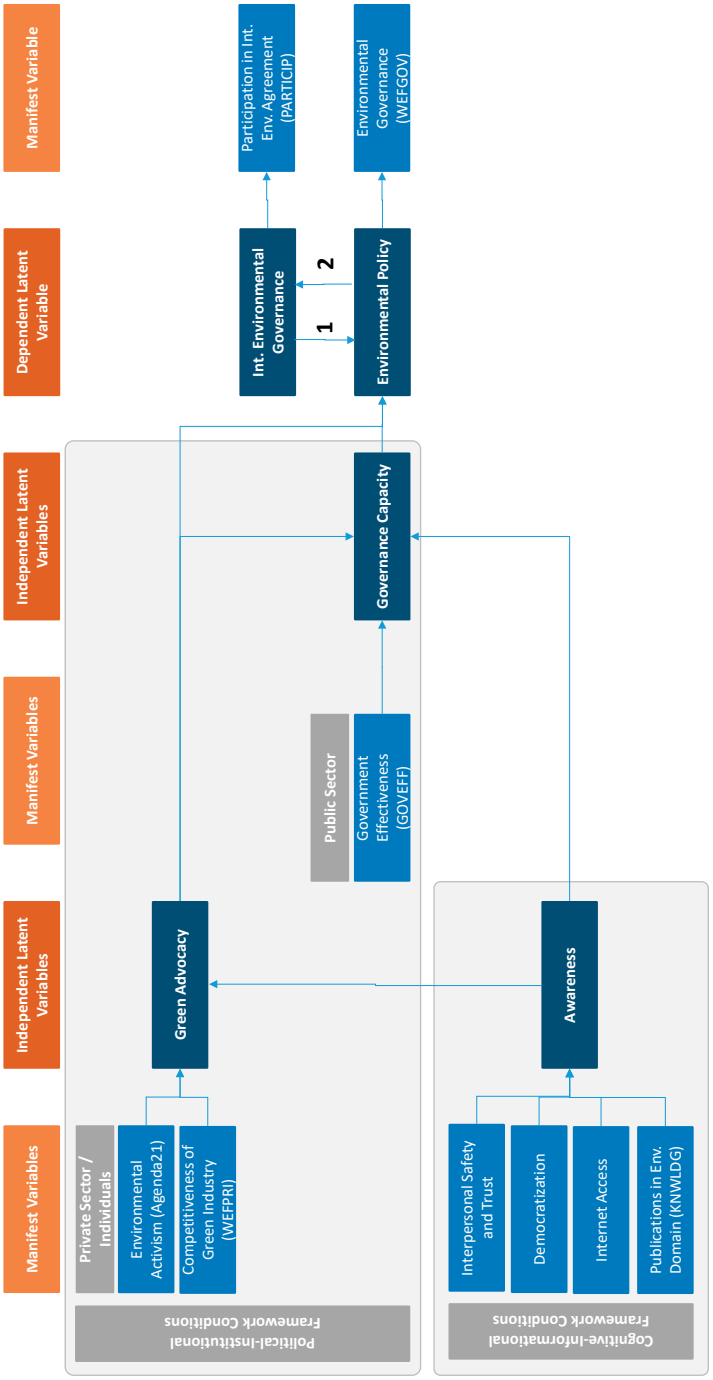

Figure 20.1 Determinants of environmental policy conditions and influences of environmental policy
Source: own illustration, related to Jaenicke (2005).

Table 20.1 Data description

Environmental Activism	Abbreviation: AGENDA21	Unit: Number of Local Agenda 21 initiatives per million inhabitants	Source: ESI, 2005	Year: 2001
Competitiveness of Green Industry	Abbreviation: WEFPRI	Unit: Min.: 7.2 Max.: 15.09=high World Economic Forum Survey on private sector environmental innovation	Source: ESI, 2005	Year: 2003/4
Government effectiveness	Abbreviation: GOVEFF	Unit: Indexed between 0 and 1=high level of effectiveness	Source: World Bank	Year: Average 2000-2002
Democratisation	Abbreviation: Democratisation	Unit: Trend-adjusted 10-year average score with high values corresponding to high levels of democratic institutions	Source: Polity IV (ESI, 2005)	Year: Average 1993-2002
Internet Access	Abbreviation: Internet Access	Unit: Internet access per 100 people	Source: World Bank	Year: Average 2000-2002
Publications in the Environmental Domain	Abbreviation: KNWLDG	Unit: Min.: 1.67 Max.: 74.67 Average rank with low values corresponding to above-average performance	Source: ESI, 2005	Year: 1993, 1998, 2003
Interpersonal Safety and Trust	Abbreviation: Interpersonal	Unit: 0=low, 1=high	Source: ISS, 2011	Year: 2000
Environmental Governance	Abbreviation: WEFGOV	Unit: Min.: 15.3 Max.: 59.74 World Economic Forum Survey on Environmental Governance	Source: ESI, 2005	Year: 2003/ 2004
Participation in international environmental agreements	Abbreviation: PARTICIP	Unit: Min.: 0 Max.: 1=full participation (score)	Source: ESI, 2005	Year: 2004

The indicator we use for Environmental Policy is the measure of *Environmental Governance* used in the World Economic Forum Survey on Environmental Governance. The indicator we use for International Environmental Governance is *Participation in international environmental agreements* as used in the Environmental Sustainability Index (ESI, 2005). The first indicator, Environmental Governance (for Environmental Policy), is a composite indicator based on the following variables: clarity and stability of regulations, flexibility of regulations, environmental regulatory innovation, leadership in

environmental policy, consistency of regulation enforcement, and environmental regulatory stringency. It is based on respondents' subjective assessment of these variables. The second indicator, Participation in International Environmental Efforts (for International Environmental Governance), has an objective basis, as it is based on the signing of treaties. The second indicator does not cover the full range of national environmental policies, and does not measure relevant details of such policies (stringency, synergies and inconsistencies, enforcement) but adds an objective element which is missing from the first indicator. In the absence of a perfect indicator for environmental policy, we decided to investigate the causal structure for two indicators of environmental policy output. For the constructs we used single indicators.

The data set was adjusted by carrying out a missing values analysis to ensure the validity of our analysis. Since, for example, more than 5% of the data cases for the variable of Publications in the Environmental Domain are missing (Hair et al., 2014, p. 51) we chose not to revert to mean replacement algorithms but apply case-wise replacement of missing values (Ringle et al., 2010). This reduced our set of observations from 71 to 47 country data sets (see Table 20.2 below).

Table 20.2 List of countries

Argentina	Ecuador	Jordan	Romania
Australia	Estonia	Latvia	Singapore
Austria	Finland	Lithuania	Slovenia
Belgium	France	Malaysia	Spain
Bolivia	Germany	Mexico	Sri Lanka
Brazil	Greece	Netherlands	Sweden
Bulgaria	Hungary	New Zealand	Switzerland
Canada	India	Nicaragua	Thailand
Chile	Ireland	Norway	Ukraine
China	Israel	Peru	United Kingdom
Colombia	Italy	Poland	United States
Denmark	Japan	Portugal	

20.4 Results and discussion

Of the three constructs representing the independent latent variables, Green Advocacy and Governance Capacity are most strongly associated with Environmental Policy (see Figures 20.2 and 20.3 below). The most important factor underlying Green Advocacy is Competitiveness of Green Industry (WEFPRI), which suggests that the demand by green businesses for Environmental Policy is more important than the Environmental Activism of civil society (AGENDA21). This is an important conclusion, which fits in with the theory (Jaenicke, 2005). Overall, the strength of the effect of Green Advocacy on

Environmental Policy is similar to that of Governance Capacity, according to the path coefficients and significance levels. This is an interesting finding because Green Advocacy incorporates environment-specific aspects, while Governance Capacity does not constitute explicit administrative capacity in the environmental domain. At the same time this is a limitation of our analysis, since there are no data available on the strength of environmental administration (which would be part of Governance Capacity) beyond the European Union countries.

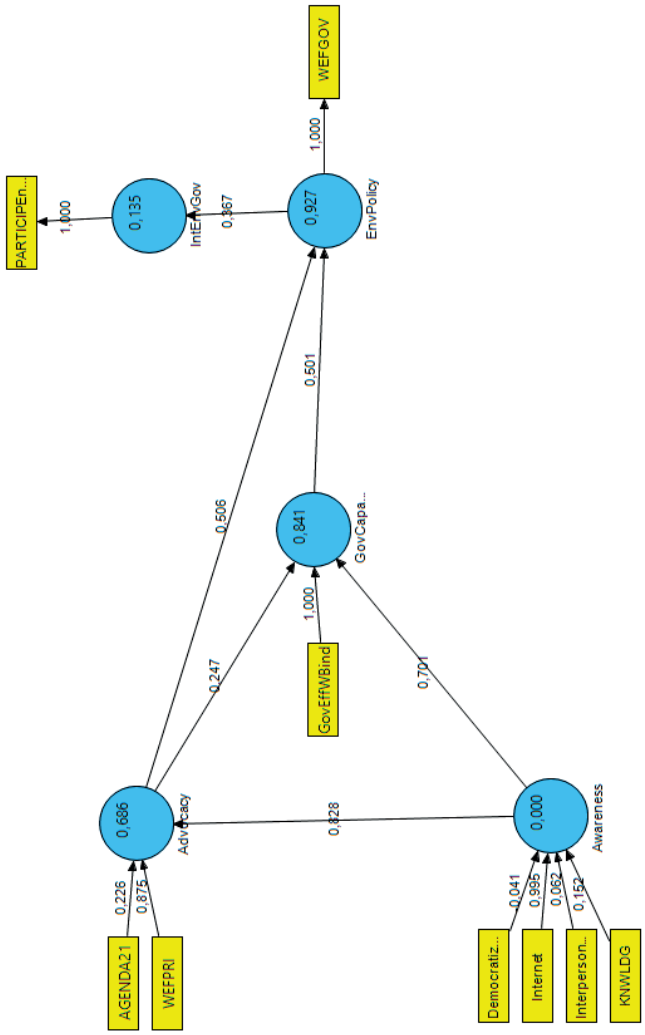

Figure 20.2 Coefficient values of Structural Equation Model
Source: based on own calculations using SmartPLS (Ringle et al., 2005). Threshold value for coefficients is 0.2. The outer loading is always 1.0 in single item constructs. Coefficients in measurement models are always between -1.0 and 1.0. The closer the number is to -1.0 or 1.0 the larger the effect of the item. Value in circle represents R^2.

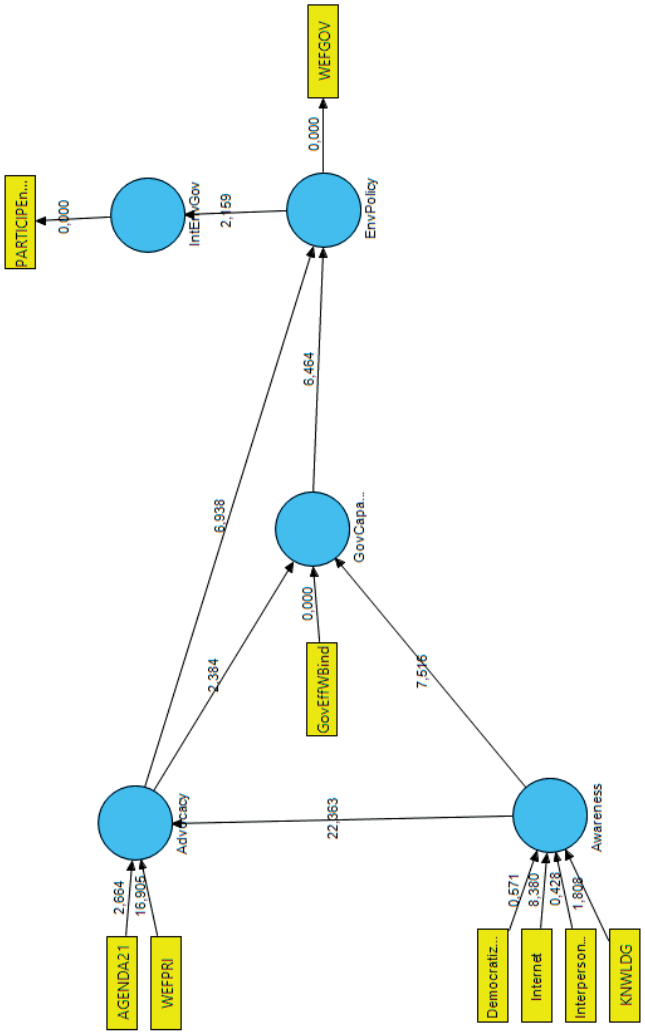

Figure 20.3 Significance values of Structural Equation Model
Source: based on own calculations using SmartPLS (Ringle et al., 2005). Threshold values for significance of 1%, 5% and 10% probability of error are 2.57, 1.96, and 1.65 respectively. Single item constructs do not have a significance level.

Internet Access is also positively associated with Environmental Policy. The influence is found to act through Advocacy and Governance Capacity, so the nature of their impact is associated with the distal, cognitive-informational framework conditions. Other studies have observed that access to information positively influences environmental performance (Esty & Porter, 2005), and we put this finding in context with other influences. The influence of Knowledge is non-significant. The ambiguity of its

categorical influence on environmental policy making is evident and has been confirmed by others as well (Krott & Suda, 2007).

Economic wealth, in the form of per capita GDP, as a separate construct, does not have a meaningful influence on Environmental Policy in our structural model. This shows that the other constructs we use in our model are robust and do not change much when economic wealth is included in the model. Nevertheless, economic wealth does have an influence on environmental policy (Esty & Porter, 2005 showed that per capita GDP has a positive influence on environmental regulatory stringency), while our analysis of polity drivers does capture it adequately.

It bears noting that the analysis of causal structures underlying environmental regulation is subject to several limitations which give guidance to future research. First, the interaction between international environmental governance and national environmental policy is not appropriately measurable with the proxy of Participation in Environmental Agreements (PATICIP). This construct requires further indicators or time series, which we do not have, to explore the international environmental policy-making dynamics in greater detail. Second, we only analysed the influence of structural determinants. In doing so, we do not want to deny the influence of strategic action in the form of wheeling and dealing and the role of the media, but our approach does not allow us to analyse such factors. Third, the influence of resistance from polluters as a negative factor, this could not be analysed because there are no statistics or any good proxies for counteracting advocacy forces. Fourth, reverse causality could not be tested simultaneously in our structural equation model, which clearly deserves further investigation, since it can be assumed that Environmental Policy and Competitiveness of Green Industry (WEFPRI) influence each other. In fact, Environmental Policy (WEFGOV) and Competitiveness of Green Industry (WEFPRI) are significantly and positively correlated (R^2 of 0.82), which could be seen as a confirmation of the Porter hypothesis (Porter & van der Linde, 2005). A final limitation, holding true for all quantitative analysis, is that all variables are subject to measurement problems. The use of different manifest variables to some extent helps to circumvent this problem. Of the various measures, we consider the construct of Government Capacity as the weakest measured variable. This is caused by the absence of information on the size and quality of environmental protection agencies or representation of green interest in parliament in the countries investigated.

Despite several limitations, the results appear rather plausible. They fit in quite well with the empirically grounded propositions by Martin Jaenicke, in particular that national green industry competitiveness and cooperation with the government have a strong positive link with environmental policy output. In addition, access to information through the internet, via the political-institutional framework, also positively contributes to environmental policy making.

It becomes apparent that the process of environmental policy making involves multiple domains, from awareness of individual interests to institutional capacities

which are part of human and institutional systems. These systems are characterised by a certain complexity in their functioning and outcomes due to uncertainty in the underlying domain of environmental problems and the multitude of individual perspectives and interactions between the sub-systems, while at the same time the development of environmental regulations does not follow a linear path (Funtowicz et al., 1999).

Statistically, 92% of the variance of environmental policy output was explained, which is very high for a model incorporating only structural factors. Thus, Structural Equation Modelling (SEM) constitutes an important avenue for building a theory of environmental policy making and testing hypotheses. We propose that it should be used more in political science and political economy analysis.

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